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Title: Using algae to solve the plastic problem

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Using algae to solve the plastic problem

By Babetta L. Marrone

Imagine our world without modern plastics—they are everywhere, from construction and electronics to transportation and packaging. Overall strength and durability make plastic so useful, but they also make plastic a leading contributor to the world's pollution problem.

According to a study performed by the National Center for Ecological Analysis and Synthesis at the University of California–Santa Barbara, as much as 13 million metric tons of plastic end up in the world's oceans each year. This study also found that about one-half of the 300 million tons of plastic produced worldwide annually is used only *once*. To put these numbers into perspective, in 2014 the United States alone sold more than 100 billion plastic beverage bottles that account for 14 percent of America's pollution problem, despite recycling efforts.

Plastics can take up to 1,000 years to decompose in landfills and oceans. Thinner plastics, such as those used for water bottles, can take more than 450 years to degrade—that's still a long time.

To address this worldwide problem, scientists at Los Alamos National Laboratory have come together to develop an alternative method to sustainably manufacture plastic that is not only durable but is easily biodegradable.

Today's plastics are typically made using chemicals derived from petroleum, a limited unsustainable resource. Plastics are synthetic (artificial) and typically consist of what are known as organic polymers. Such polymers are made from smaller, identical molecules linked together. Some polymers occur in nature (cellulose, for example, is made up of sugar molecules), whereas others are made artificially (like nylon, Teflon and polyvinyl chloride, more commonly known as PVC).

Rather than use petroleum to manufacture synthetic plastics, Los Alamos is looking to an alternative, environmentally friendly resource, namely algae. Already a viable alternative energy resource for fuel, algae may also prove useful as a base material to create biology-based polymers, commonly known as biopolymers, that are strong and durable but decompose more quickly than their petroleum-based counterparts.

Discovering which algae is best suited as base material for biopolymer manufacturing is no easy task. There are many types of algae, from the microscopic (such as blue green algae, or cyanobacteria, so-called because of its bluish-green color) to large seaweeds that grow to more than 100 feet long. To narrow down which type would be best for manufacturing biodegradable plastics, three Lab teams are pursuing separate goals.

One team, primarily biologists, is investigating the biological characteristics found in every species of algae. They are particularly interested in each algae's genetic makeup, its genome, which contains all the biological information needed to synthesize the building blocks for making biopolymers. The second team, primarily chemists, is ascertaining the chemical processes necessary to discover, design and manufacture new biopolymers that are as strong and durable as petroleum-based plastics but degrade much faster.

Combing through such mountains of information could take many decades, so a third team is applying machine-learning analysis to speed up the work. Machine-learning algorithms can actually learn from data, identify patterns, and even make decisions, all without human participation.

By harnessing the rich and vast landscape of algae biology and polymer chemistry, we will create a framework from which to design a new generation of biopolymers that serve as the basis for revolutionary new bioplastics. Such bioplastics will stop adding to problems such as the Great Pacific Garbage Patch off the coast of California. This garbage patch, twice the size of Texas, has six times more plastic than sea life. Bioplastics are one way to keep using plastics, which are a key part of our everyday lives, without polluting the earth and water for generations to come.

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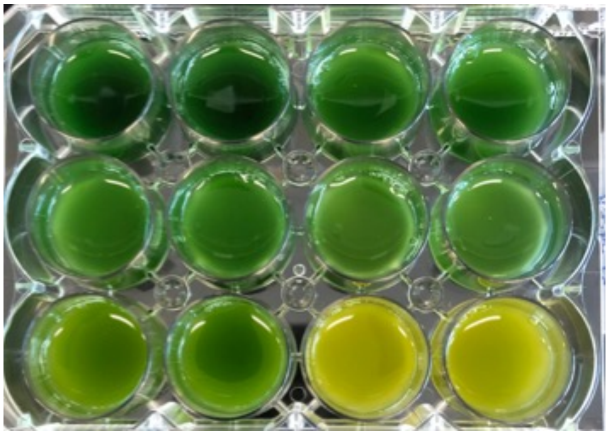
Photos and Captions



Biologists have cultured these algae, known as cyanobacteria, with different nutrients in different amounts, resulting in distinct color changes.

A senior scientist for the Bioenergy and Biome Sciences group at Los Alamos National Laboratory, Babetta L. Marrone is the Principal Investigator for the new project funded by Los Alamos, "Biomanufacturing with Intelligent Adaptive Control (BioManIAC)". Marrone also serves as the Biofuels Program Manager at Los Alamos and oversees projects funded by the Department of Energy's Bioenergy Technologies Office.